

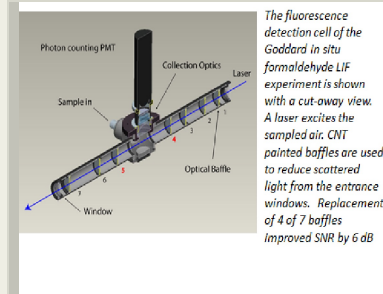
## Project Introduction

GSFC has successfully demonstrated significant progress in developing carbon nanotubes for many space applications, especially extreme stray light suppression. Coronagraphy is among the most challenging applications, and the most challenging (but necessary) form is a 3-dimensional coronagraphic baffle. In this IRAD we will build a solar baffle and address difficult technical barriers, namely catalyst deposition and uniform growth on a complex tube used for a novel compact coronagraph. This is enabling technology for all other science applications both imaging and non-imaging.

We have developed carbon nanotube formulations primarily geared towards enhanced stray light control on a variety of instruments. IRAD has supported development of this technology to make it 10 to 100 times blacker than alternate surface treatments from the Near UV to Far Infrared and a large variety of substrates suitable for space flight instrumentation. In addition, we have performed the first growth on catalyst applied to substrates using Atomic Layer Deposition (ALD). Catalyst is normally deposited using thermal or e-beam evaporation which allows for coating flat surfaces. Many baffles are dimensional, curved or complex, requiring conformal deposition. The development of a conformal nanotube process is enabling to many applications. We have demonstrated ALD of iron catalyst out of house and hope to achieve an in-house capability. Ellipsometry performed on the part verified sub nanometer uniformity of catalyst across a test part. The compact coronagraph baffle is larger and more complex which will pose a significant challenge in maintaining uniformity over a larger third dimension. In addition, we must solve the problem of managing feedstock gas flow in our nanotube furnace during chemical vapor deposition (CVD). We have seen significant shadowing and non uniformity of growth due to laminar flow at substrate edges. Modeling of the gas flow has begun and will be useful in solving this problem. In addition we are performing our occulter growth using a reflector to direct feedstock gas to the shadowed side of the mask. Our goal will be to address these challenges and deliver a solar coronagraphic mask that is applicable to other scientific observations.

## Anticipated Benefits

N/A



Project Image ROE FY11 CIF  
259 CC Nanostructures for  
Advanced Imaging and Detector  
Devices

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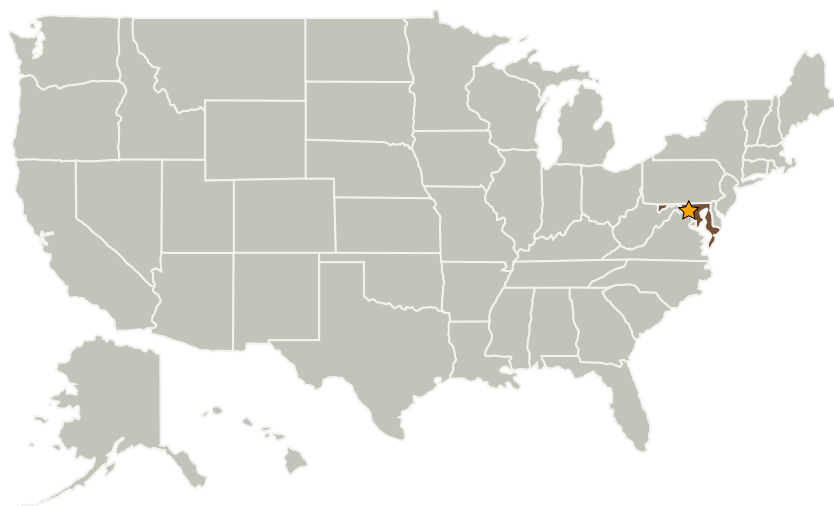
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## Nanostructures for Advanced Imaging and Detector Devices

Completed Technology Project (2011 - 2013)



## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Goddard Space Flight Center (GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

## Primary U.S. Work Locations

Maryland

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Goddard Space Flight Center (GSFC)

**Responsible Program:**

Center Innovation Fund: GSFC CIF

## Project Management

**Program Director:**

Michael R Lapointe

**Program Manager:**

Peter M Hughes

**Project Manager:**

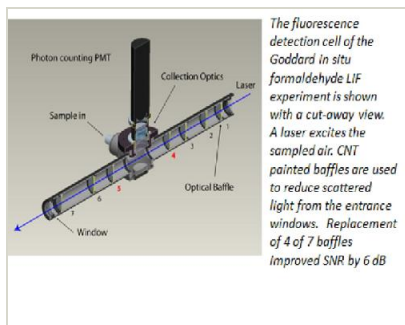
Theodore D Swanson

**Principal Investigator:**

John G Hagopian



## Images



### 85.jpg

Project Image ROE FY11 CIF 259

CC Nanostructures for Advanced Imaging and Detector Devices

(<https://techport.nasa.gov/image/1173>)

## Links

ASA Engineer Achieves Another Milestone in Emerging Nanotechnology

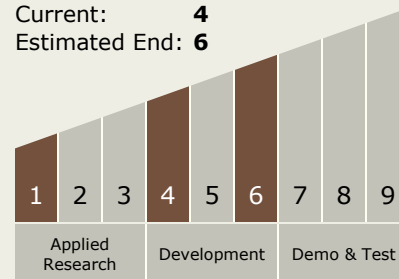
(<http://www.nasa.gov/content/goddard/nasa-engineer-achieves-another-milestone-in-emerging-nanotechnology/#.U2p3zhC9Z8F>)

## Project Website:

<http://aetd.gsfc.nasa.gov/>

## Technology Maturity (TRL)

Start: **1**  
Current: **4**  
Estimated End: **6**



## Technology Areas

### Primary:

- TX01 Propulsion Systems
  - └ TX01.4 Advanced Propulsion
    - └ TX01.4.1 Solar Sails